Graph Theory Midterm: Stuff to Know

1 General Info

- Exam will be in-class Tuesday June 11, in **DCC 308**
- Exam will be closed notes, closed book, closed neighbor
- **One** two-sided crib sheet is allowed (written or printed)
- Material will cover Chapters 1-4 of the book AND additional material and algorithms covered in class
- Know everything in the online notes that's in bold
- Questions will require direct knowledge of the definitions and graph properties we discussed, applying algorithms and knowledge to problems, and working through proofs.

The following material is only a guide. Regardless of what is listed below, everything discussed in class and in the online notes can appear on the test unless explicitly stated otherwise.

2 Chapter 1

1. Basic graph definitions/classes - terminology, every term in bold in the notes; what makes a graph simple; what are complete graphs, bipartite graphs
2. Graph representations - adjacency matrices; special classes of adjacency matrices; permutation matrices
3. Walks, cycles, paths, trails, etc. - definitions and differences; usage in proofs
4. Isomorphism - properties of isomorphic graphs; isomorphic classes; demonstrating isomorphism
5. Eulerian graphs - directed and undirected properties
6. Graphic sequences - how to verify an integer sequence is graphic; create a graph using a given sequence
7. Connectivity - undirected connectivity properties; strong and weak connectivity

3 Chapter 2

1. Trees - basic properties; Cayley's formula; Prüfer Codes and algorithms
2. Distances - diameter; radius; eccentricity; center
3. Spanning Trees - counting; edge contraction method
4. Graceful Labeling - what makes a graph graceful; what kinds of graphs are graceful
5. Minimum Spanning Tree - Krushkal's and Prim's algorithms
6. Shortest Paths - Dijkstra's Algorithm

4 Chapter 3

1. Matching - perfect/maximal/maximum; Berge's Theorem; Hall's Condition; Tutte's Condition; symmetric differences; M-augmenting and M-alternating paths
2. Covers - vertex and edge covers; independent sets and independence number; König-Egerváry Theorem
3. Maximum Bipartite Matching - Augmenting Paths Algorithm
4. Maximum General Matching - Edmond's Blossom Algorithm

5 Chapter 4

1. Vertex connectivity - separating sets; cut vertices; minimum separators
2. Edge Connectivity - disconnecting sets; edge cut; edge connectivity of digraphs
3. Biconnectivity - blocks; articulation vertices; block-cutpoint graphs
4. 2-connectivity and k-connectivity - Whitney's connectivity theorem; open and closed-ear decompositions; Menger's Theorem
5. Network Flow - Fork-Fulkerson/Edmonds-Karp algorithms; f-augmenting paths; Max-flow Min-cut Theorem

6 Other

1. Proofs - induction; necessity and sufficiency; extremal arguments
2. PageRank - algorithm variants; linear algebraic model using adjacency matrix
3. Directed Acyclic Graphs - properties; Tarjan's topological sorting algorithm
4. Breadth-first Search - applications to various problems